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SOURCES OF TANKER TONNAGE FOR WARTIME LOGISTICAL SUPPORT: PROJECTIONS OF THE COMMERCIAL FLEET AND THE READY RESERVE FORCE

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1. Enclosure (1) is forwarded as a matter of possible interest.

2. This is the second in a series of anticipated publications prepared in connection with CNA's Strategic Sealift project. This research contribution projects the size of the U.S.-flag commercial tanker fleet over the next 25 years, and estimates the required size of the tanker portion of the Ready Reserve Force.

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ABSTRACT

This research contribution makes projections of tanker tonnage and the numbers of tankers available to support U.S. forces in wartime for 1990, 1995, 2000, and 2010. The key finding of the analysis is that the supply of tankers will fall far short of estimated Department of Defense (DOD) requirements. This rapid shrinkage of tankers is deemed likely because domestic crude oil production is projected to decline substantially, and because additional pipeline construction is underway. If DOD continues to rely on the Ready Reserve Force to fill the shortfall in the numbers of available tankers, by the mid-1990s the fleet of reserve tankers would have to be expanded to about triple the size DOD currently anticipates. Accordingly, the study recommends that the Navy consider the alternative policy of outsourcing for delivering fuel to armed forces during wartime.

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INTRODUCTION

Commercial tanker capacity under the U.S. flag has been declining and is expected to continue doing so in the years ahead. Since 1970, the number of U.S.-flag tankers that are militarily useful has fallen about 60 percent, and the carrying capacity of this component of the fleet has decreased about 30 percent. In the event of a major armed conflict at the end of the decade, it is unlikely that the remaining U.S.-flag tankers would be capable of providing adequate logistical support for both U.S. armed forces and essential economic activity. By the mid-1990s, the shortfall is expected to be even greater.

U.S.-flag tankers are not competitive on international trade routes, where they face competition from foreign-flag ships. To operate under the U.S. flag, a tanker must be constructed in a U.S. shipyard and must be manned with U.S. nationals. For about one-third the cost, comparable vessels can be built abroad and operated with foreign crews. In the past, these cost disadvantages were offset, at least partially, by construction differential subsidies (CDS) and operational differential subsidies (ODS). Under the current administration, however, CDS has been cancelled and no new ODS contracts are being offered, although payments under existing contracts are continuing. If maritime policies are not changed, few if any U.S.-flag tankers will survive on international routes.

Under the Jones Act, the domestic trades are protected; only U.S.-flag tankers can transport crude oil and refined petroleum products from point to point within the United States, including Alaska, Hawaii, and Puerto Rico. Tankers in these trades enjoy a protected market and thus do not receive any subsidy payments. Nonetheless, Jones Act tankers still face competition from alternative modes of transportation: pipelines and barges. Unfortunately, domestic crude oil production is expected to decline at least through the mid-1990s, and pipelines and barges are likely to capture larger shares of the shrinking market. Thus, tankers will be less in demand.

The Navy has responded to these trends by purchasing militarily useful tankers that otherwise would be scrapped by owners unable to operate them profitably. The tankers are maintained in a high degree of readiness in the Ready Reserve Force (RRF). In this way, the shrinkage can be curtailed. Valuable assets merely are transferred from private ownership to ownership by the U.S. Navy.

A pressing question is: How large can the RRF tanker fleet grow relative to the active U.S.-flag tanker fleet and still be a workable option for

maintaining adequate tanker capability? In the event of RRF activation, the Maritime Administration exercises General Agency Agreement contracts with commercial operators, who have agreed to obtain merchant mariners for the RRF ships from union sources. Of course, this procedure is workable only as long as sufficient numbers of merchant sailors are available. If the active commercial fleet continues to decline, as appears likely, unemployed or underemployed sailors will switch occupations, and more yards will close. Furthermore, in an era of increasingly austere defense budgets, a large tanker RRF simply may not be affordable.

The study results reported in this paper indicate how large the RRF would have to be to fill the shortfall between tanker requirements and available capacity. Specifically, the size of the RRF in future years is estimated by using the Department of Defense (DOD) estimate of tanker capacity required to support military operations and subtracting the projected U.S.-flag tanker capacity that will be available, as determined from this research.

FINDINGS AND RECOMMENDATIONS

The tanker fleet under U.S. flag is projected to continue its rapid decline through the mid-1990s. At that time, the fleet is likely to "hit bottom" far short of the numbers needed to support military operations. To fill the shortfall, the tanker portion of the RRF would have to be expanded to about 104 handy-sized tanker equivalents (HSTEs) by 1990, and 129 by 1995. These numbers are shown in table 1.

TABLE 1

PROJECTED SIZE OF THE RRF TANKER FLEET
(Thousands of deadweight tons)

	1984	1990	1995	2000
Required fleet[a]	7,416	7,416	7,416	7,416
Active fleet[b]	8,635	4,554	3,864	3,954
RRF fleet	259[c]	2,862	3,552	3,462
RRF fleet in HSTEs	9	104	129	126

a. These are DOD estimates for 1990-91. The figure is assumed to be the same for other years.
b. Tankers withheld for identified military requirements (with total capacity of 415,000 DWT) are not included.
c. The actual tonnage.

Required tanker capacity to support military operations is shown in line 1 of table 1 in thousands of deadweight tons (DWT). The requirement was determined in [1] for the year 1990. Requirements were not estimated for later years, so the figure is assumed to remain unchanged. In line 2, the projected capacity of the active fleet is shown. It is made up of militarily useful tankers in the U.S.-flag commercial fleet, the Military Sealift Command (MSC) fleet, and the Effective U.S. Control (EUSC) fleet. The latter is composed of vessels owned by U.S. citizens or corporations that operate under flags of convenience. By doing so, these owners avoid the sizable costs of building and crewing in the U.S. It is assumed by DOD that EUSC tankers would be made available during a military crisis.

The RRF is sized to fill the shortfall, as shown in line 3 in thousands of DWT and in line 4 in handy-sized tanker equivalents (HSTEs). An HSTE is defined as a tanker with a 200,000-barrel capacity. A little less precisely, an HSTE can be defined as a 27,500-DWT coated tanker. These definitions are merely common denominators; the actual tankers acquired for the RRF need not be 27,500 DWT. Only militarily useful tankers are candidates for the RRF, and they may be larger than 27,500 DWT. A tanker generally is deemed militarily useful if it is between 6,000 and 82,000 DWT, and if its tanks are coated. The latter is necessary to facilitate the cleaning of the tanks between shipments. Some tankers in the 90,000-DWT class also are considered militarily useful. To the extent that tankers larger than 27,500 DWT are acquired, the actual number of tankers in the RRF would be less than the HSTE number.

Acquiring an RRF of 129 handy-sized tankers is not the end of the story, however. Although 129 HSTEs, along with tankers of the active U.S.-flag and EUSC fleets, would be adequate to fulfill the requirement for direct military support, they would not fulfill the requirement for essential economic support. The *Economic Support Shipping* study conducted by the Maritime Administration [2] found that economic support would require militarily useful tanker capacity of about 1.3 million DWT, or about 45 HSTEs. DOD intends to meet this additional requirement by purchasing tankers for the National Defense Reserve Fleet (NDRF). The RRF is an "elite subset" of the NDRF. Other components of the NDRF—including the economic-support tankers—generally are older and are maintained in a lower state of readiness.

According to the CNA projections of U.S.-flag tanker capability, the tanker shortfall will be considerably larger than earlier DOD estimates. As shown in table 2, the DOD sealift tanker analysis [1] originally anticipated a need for only 16 handy-sized tankers in the RRF in 1990. Later developments

prompted a downward revision of the DOD projections of commercial tanker fleet size and a consequent upward revision of the tanker component of the RRF to 46. The CNA estimate of 104 is the result of a detailed modeling process (described herein) that derives projections of the commercially viable U.S.-flag tanker fleet from projected requirements to move crude oil and refined petroleum products around the U.S. Explicit account was taken of developments in petroleum and tanker markets that were not as readily identifiable at the time of the DOD analysis: the outlook for domestic oil production is substantially weaker for both 1990 and 1995, and pipeline capacity is expected to expand more rapidly.

TABLE 2

SIZING THE TANKER RRF FOR 1990: ORIGINAL ESTIMATE AND REVISIONS

	HSTEs
Original DOD estimate	16
Revised DOD estimate	46
CNA control estimate	104

These findings raise serious doubts about the viability of the RRF as the sole offset to the shrinking commercial tanker fleet over the long term. By 1995, the capacity in deadweight tons of active militarily useful tankers flying the U.S. flag will be about 2.8 million—2.2 million for the commercial fleet and another 0.6 million for the MSC fleet. To fill the requirements shortfall, RRF capacity would have to be larger than that of the active fleet: about 3.6 million, or over 50 percent of the total tanker assets under the U.S. flag. Even if the capability to crew and activate a large RRF continued to exist, the costs of procuring, upgrading, and maintaining it probably would be about triple the cost anticipated by the Navy for a 46-tanker RRF in 1990. (The precise costing of the RRF through 2010 will be reported in a subsequent paper.)

The only other option for delivering the fuels required to support military operations is outsourcing: reliance by DOD on foreign refineries and possibly on foreign-flag, foreign-owned tankers. A recommendation that follows from the findings of this study is that the Navy examine closely the outsourcing option. It would be a major departure from current wartime logistical planning, but in the absence of substantial changes in U.S. maritime

policies, it probably will not be possible to maintain enough tanker capability under U.S. flag to meet currently defined DOD requirements.

TANKER FLEET PROJECTIONS

The CNA projections of the militarily useful tanker assets available to support military operations are shown in table 3 for 1990, 1995, and 2000. The RRF component of the fleet represents current DOD plans to increase its size to 46 HSTEs. Thus, tanker shortfalls of about 58 HSTEs in 1990 and 83 HSTEs in 1995 are projected to remain even after current DOD plans to expand the RRF are carried out.

The reason for the remaining shortfalls is that the U.S.-flag commercial tanker fleet is expected to decline substantially faster than the earlier DOD projections had anticipated. The projections for the other components of the fleet, MSC tankers and EUSC tankers, are almost identical to those made by DOD. The MSC fleet is expected to remain constant, and the EUSC component is carried over from [1] merely to maintain comparability. In [1] the capacity of the EUSC fleet was assumed to remain at its 1985 level. That assumption was justified by arguing that it was difficult to project with much precision how the size of the EUSC fleet might change in the years ahead, so it was preferable to not count on growth that might not occur. In addition, the EUSC fleet is viewed as something of a weak link in the available fleet, because there is doubt among some observers about whether these tankers would be made available. After all, they are mainly under Liberian flag and have Third World crews. The CNA analysis has focused on U.S.-flag assets. More in-depth projections of the EUSC fleet would require a separate analysis.

Details of the CNA projections of the U.S.-flag commercial tanker fleet are displayed in tables 4 and 5. Table 4 contains projections for the whole fleet, and table 5 shows projections of the militarily useful component. Vessels in the domestic or Jones Act trades are of two types:

- Crude-carrying tankers that move Alaskan North Slope and offshore California oil to the West Coast, Hawaii, the Virgin Islands (via the Cape), and Panama; and from Panama to the Gulf Coast, East Coast, and Puerto Rico.

- Clean-product tankers that move refined products from the Gulf Coast to the East Coast, fromPuerto Rico and the Virgin Islands to the East Coast, and along the U.S. coasts.

TABLE 3

PROJECTED SHORTFALLS OF MILITARILY USEFUL TANKERS
(Thousands of deadweight tons)

	1990	1995	2000
Total militarily useful fleet	6,239	5,549	5,639
MSC	576	576	576
U.S. commercial	2,897	2,207	2,297
RRF	1,270	1,270	1,270
EUSC	1,496	1,496	1,496
Less: Ships withheld for identified military requirements	415	415	415
Equals: Available militarily useful fleet	5,824	5,134	5,224
Required fleet	7,416	7,416	7,416
Shortfall	1,592	2,282	2,192
Shortfall in HSTEs	58	83	80

TABLE 4

PROJECTED U.S.-FLAG COMMERCIAL TANKER FLEET

	1990	1995	2000
Jones Act trade	79	61	77
Refined products	35	38	38
Crude oil	44	23	39
CDS	12	8	0
Total	91	69	77
Total in thousands of DWT	6,878	4,506	5,666

TABLE 5

MILITARILY USEFUL TANKERS IN
U.S.-FLAG COMMERCIAL FLEET

	1990	1995	2000
Jones Act trade	51	43	51
Refined products	35	38	38
Crude oil	16	5	13
CDS	12	8	0
Total	63	51	51
Total in thousands of DWT	2,897	2,207	2,297

All of the tankers operating in the refined product trades are militarily useful, while the bulk of the crude-carrying tankers are not. These latter tankers are too large, and some of their tanks are uncoated and thus too difficult to clean sufficiently to carry refined products. The crude-carrying tankers are projected to decline rapidly in number through the mid-1990s, largely reflecting the anticipated declines in Alaskan North Slope oil output.

Tankers operating in the refined product trades show no further shrinkage after 1990, because their trade is not affected by the increased imports of crude oil that will be necessary to compensate for the declines in domestic production. The crude oil refined on the Gulf Coast—whether domestic or imported—still must be transported to the East Coast in Jones Act tankers if it is to move by tanker at all. The bad news for military planners is that most of the Gulf-to-East Coast trade is likely to be captured by barges and pipelines. For example, in 1990, refined product shipments from the Gulf Coast to the East Coast are projected at a rate of 2.7 million barrels per day, but only about 27 percent will be carried over water. The rest will move by pipeline. Moreover, of the 731,000 barrels per day left over for waterborne carriage, about 58 percent will be shipped in barges, leaving only about 314,000 barrels per day for clean-product tankers. Accordingly, their remaining numbers are small in the 1990s.

The CDS fleet is comprised of tankers that were built for international trade. They received CDS funds for construction, and they continue to receive ODS payments under existing contracts. Unless they are granted special 6-month waivers, these tankers are excluded from the Jones Act trades. Instead, they must compete against foreign-flag vessels on international

routes. At present, ten large tankers comprising more than 60 percent of the CDS tonnage are laid up, because international rates have hovered near cash costs as a result of excess tanker supply. Even with ODS payments, operating costs of U.S. tankers are well above those of foreign competitors. This situation is not likely to improve anytime soon: more than 80 very large crude carriers (VLCCs) and ultralarge crude carriers (ULCCs) were scrapped from the world tanker fleet, but the decrease in supply was offset by a 10-percent decline in worldwide demand in 1985. The laidup U.S.-flag tankers were built in the mid-1970s and are approaching the midpoint of their expected lives. The longer they remain in layup, the greater the costs of activation; and the older they are, the less the payback. Given the bleak outlook for carriage rates over the next few years, it is unlikely that these tankers have any future other than the boneyard.

CDS tankers currently have the option of paying back construction-differential subsidies and entering the Jones Act trades. This CDS payback option has a 1-year window that ends in June 1986. Reference [1] projected that 22 CDS tankers—almost the entire fleet—would opt for payback and displace some of the older, smaller tankers currently operating in the Alaskan trades. That would have been an unfortunate development for the Navy, because the tankers likely to have been displaced are militarily useful, while the VLCCs and ULCCs that might have entered the domestic trades are not. Fortunately, however, the DOD projection was far too high. To date, only two tankers have exercised the option, and the total is unlikely to go higher than three. Why have more ULCCs and VLCCs not chosen to enter a market in which they would be able to compete against older, less efficient U.S.-flag ships and face no competition from foreign vessels? Because their rates would have to incorporate the CDS payback costs, while many of the tankers currently in the Alaskan trades need only cover operating costs. Under such circumstances, the CDS vessels would not be able to capture cargo at profitable rates.

About a dozen smaller CDS tankers—ranging from 35,000 to 92,000 DWT— probably will survive to 1990, and only about eight still will be active in 1995. Before 2000, under current maritime policies, the entire CDS fleet will have vanished because ODS contracts will have expired. At present, 17 CDS tankers are operating mostly in trades generally reserved for U.S.-flag ships: short term, or spot charters to MSC, and grain shipments under special government programs (such as Public Law 480). The small number of CDS tankers that might continue operating in the early 1990s will be relying primarily on these sources for business.

WHY THE PROJECTIONS DIFFER

The CNA projections of active tanker capacity in 1990 are substantially lower than those made by DOD. Table 6 quantifies the main factors responsible for the difference. DOD originally projected that the U.S.-flag commercial tanker fleet would consist of 155 ships in 1990, and that 106 of them would be militarily useful. Later, DOD adjusted its projection downward to account for the anticipated building of the transgulf pipeline and for CDS payback. In retrospect, these adjustments were largely unnecessary. The transgulf pipeline project was to have converted a gas-transmission pipeline between Baton Rouge and Port Everglades to clean-products service. If so, about eight militarily useful tankers would have been displaced from the Gulf-to-East Coast trades. However, the project has been defeated by a coalition of marine and environmental interests.

TABLE 6

WHY THE PROJECTIONS DIFFER

	U.S.-flag commercial tankers
Original DOD projection [1]	155
CDS payback	- 3
All American pipeline	- 11
Stiffer foreign competition	- 11
Lower domestic crude production	- 30
Larger average vessel size	- 9
CNA projection	91

The factors other than CDS payback that are listed in the table were not accounted for in the DOD estimates. The All American pipeline will carry crude oil from California to the Gulf Coast, displacing about 11 tankers on the West Coast-to-Panama and Panama-to-Gulf Coast routes. A larger displacement—about 30 tankers—will result from lowered projections for domestic crude oil production. When oil prices are low, domestic exploration, drilling, and development grinds to a halt because it is cheaper to import more oil from developed fields abroad. The bulk of imported oil arrives in lower cost foreign-flag tankers. The current weakness in oil markets is unlikely to reverse itself quickly; its continuation over the next few years limits domestic

crude oil output levels into the mid-1990s. As discussed above, CDS tankers cannot compete against foreign-flag tankers in the present pricing environment, and as a result, about 11 of these tankers are likely to be scrapped before 1990. Finally, some of the smaller tankers in the West Coast trades probably will be squeezed out not so much because of CDS payback, but more generally because of tough competition in a declining market.

TRANSLATING OIL FLOWS INTO TANKER TONNAGE

Of the three components of the U.S.-flag tanker fleet, only the Jones Act tankers were projected on the basis of the model presented in this section. The procedure is displayed in tables 7 through 11 and is briefly described in the accompanying text. The methodology and data sources for this model are fully explained in a separate paper [3]. The other fleet components—MSC tankers and CDS tankers—were projected differently, as explained above.

The Jones Act tanker fleet derives its business from the movement of crude oil and refined petroleum products around the United States. The first task is to project shipments of crude oil and of refined products between different regions. For that purpose, the country—including the Virgin Islands and Puerto Rico—is divided into Petroleum Administration for Defense Districts, or PADDs. The projected crude oil flows underlying the tanker projection are shown for 1990 in table 7, and the corresponding refined product flows are shown in table 8. The procedure begins with projections of the totals in the right-hand column. These totals are allocated among the PADDs under the assumption that the current pattern of oil flows reflects production, cost, and marketing efficiencies that are slow to change. By making use of the accounting identity between sources and uses of oil for each PADD (and current patterns of inter-PADD shipments and receipts) the projections for shipments to other PADDs are derived.

Next, shipments are further disaggregated by (1) mode of transportation and (2) PADD of destination. This is necessary because tanker demand varies with destination and length of trade route, and also because different shares of trade are captured by pipelines and barges on different routes. These projections are shown in tables 9 and 10. The key numbers to focus on in table 9 are waterborne shipments out of PADD V (the West Coast, including Alaska). This trade supports an important segment of the Jones Act crude-carrying tanker fleet. The other source of commercial business for Jones Act crude-carrying tankers is trade within PADD V, from Valdez (Alaska) to the West Coast and to Hawaii. That trade is examined in table 11. It can be seen in

table 9 that crude oil also is carried via water from PADD III (the Gulf Coast) to PADD II (the Midwest). Only small inland vessels are employed on that route, hence they are ignored in this study. About 400,000 barrels of crude per day are projected to move by pipeline from PADD V to PADD III, mainly through the All American pipeline. Should that pipeline fail to materialize, tanker demand would be up by about 11 vessels.

TABLE 7

PROJECTED CRUDE OIL
FLOWS IN 1990
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Crude oil production	76	760	3,420	532	2,812	0	7,600
Crude oil imports	1,007	1,536	2,833	30	264	330	6,000
Receipts from other PADDS	91	778	572	0	0	119	
Total crude supply	1,174	3,074	6,825	562	3,076	449	13,600
Uses							
Crude runs	1,129	3,074	6,134	476	2,339	449	13,600
Shipments to other PADDS	45	0	691	86	737	0	
Crude oil exports	0	0	0	0	0	0	0

TABLE 8

PROJECTED REFINED PRODUCT
FLOWS IN 1990
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Refined product production	1,129	3,074	6,134	476	2,339	449	13,600
Refined product imports	1,432	288	360	24	168	128	2,400
Receipts from other PADDS	3,173	1,254	217	84	137	0	
Other product supply	231	378	1,197	63	231	0	2,100
Total product supply	5,965	4,994	7,908	647	2,875	577	18,100
Uses							
Refined product consumption	5,512	4,550	4,025	551	2,625	236	17,500
Shipments to other PADDS	422	401	3,605	96	0	341	
Product exports	31	43	279	0	250	0	600

TABLE 9

PROJECTED INTER-PADD CRUDE OIL
FLOWS IN 1990
(Thousands of barrels per day)

Shipments	Receipts						
	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	0	45	0	0	0	45
PADD II	0	0	0	0	0	0	0
PADD III	0	622	0	0	0	0	622
PADD IV	0	86	0	0	0	0	86
PADD V	0	0	400	0	0	0	400
VI/PR	0	0	0	0	0	0	0
Total	0	708	445	0	0	0	1,153
			WATERBORNE				
PADD I	0	0	0	0	0	0	0
PADD II	0	0	0	0	0	0	0
PADD III	0	69	0	0	0	0	69
PADD IV	0	0	0	0	0	0	0
PADD V	91	0	127	0	0	119	337
VI/PR	0	0	0	0	0	0	0
Total	91	69	127	0	0	119	406
			TOTAL				
PADD I	0	0	45	0	0	0	45
PADD II	0	0	0	0	0	0	0
PADD III	0	691	0	0	0	0	691
PADD IV	0	86	0	0	0	0	86
PADD V	91	0	527	0	0	119	737
VI/PR	0	0	0	0	0	0	0
Total	91	777	572	0	0	119	1,559

TABLE 10

PROJECTED INTER-PADD REFINED PRODUCT FLOWS IN 1990
(Thousands of barrels per day)

Shipments	Receipts						
	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	200	0	0	0	0	200
PADD II	100	0	165	84	0	0	349
PADD III	2,001	706	0	0	89	0	2,796
PADD IV	0	48	0	0	48	0	96
PADD V	0	0	0	0	0	0	0
VI/PR	0	0	0	0	0	0	0
Total	2,101	954	165	84	137	0	3,441
			WATERBORNE				
PADD I	0	222	0	0	0	0	222
PADD II	0	0	52	0	0	0	52
PADD III	731	78	0	0	0	0	809
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	0	0	0	0	0
VI/PR	341	0	0	0	0	0	341
Total	1,072	300	52	0	0	0	1,424
			TOTAL				
PADD I	0	422	0	0	0	0	422
PADD II	100	0	217	84	0	0	401
PADD III	2,732	784	0	0	89	0	3,605
PADD IV	0	48	0	0	48	0	96
PADD V	0	0	0	0	0	0	0
VI/PR	341	0	0	0	0	0	341
Total	3,173	1,254	217	84	137	0	4,865

TABLE 11

PROJECTED U.S.-FLAG DOMESTIC TANKER DEMAND IN 1990

		Thousands of barrels per day	Factor	Thousands of DWT	Average size of vessel	Number of vessels
Crude oil						
Alaskan North Slope						
Valdez	– USWC	1,409	2.20	3,100	124	25
	– Panama	247	4.63	1,141	178	6
	– Hawaii	54	2.67	144	73	2
	– VI (via Cape)	90	– [a]	– [a]	– [a]	– [a]
Puerto Armuelles						
	– USG/PR	0				
	– USEC	31	3.14	97	50	2
Chiriqui Grande						
	– USG/PR	153	1.79	274	50	6
	– USEC	63	2.37	149	50	3
Total Alaskan North Slope				4,905		44
Offshore California						
	– USG	0	5.31	0	43	0
	– USEC	0	5.72	0	41	0
Refined petroleum product						
Tanker shipments						
USG	– USEC	314	2.0	628	38	17
USWC	– USWC			527	38	14
USEC	– USEC			156	38	4
Total tanker shipments				1,311		35
Barge shipments						
USG	– USEC	417	1.25	521	20	26
USWC	– USWC			223	20	11
USEC	– USEC			727	20	36
Total barge shipments				1,471		73

a. Shipments to the Virgin Islands are not covered under the Jones Act; they can be carried in foreign-flag tankers.

In table 10, the waterborne trade that generates the bulk of clean-product tanker demand is from PADD III (Gulf Coast refineries) to PADD I (the East Coast). About 58 percent of these shipments are expected to move by barge, however, not by tanker. Waterborne carriage from PADD I to PADD II, from PADD II to PADD III, and from PADD III to PADD II is in small inland vessels. Trade from the Virgin Islands (VI) and Puerto Rico (PR) to PADD I (the East Coast) is expected to generate only modest amounts of business for U.S.-flag tankers, because the Virgin Islands is exempt from the Jones Act. Some trade between the Virgin Islands and the East Coast has moved in U.S.-flag tankers, but it is vulnerable to foreign competition. Puerto Rico is under the Jones Act, but over 85 percent of the projected shipments from VI/PR are out of the Virgin Islands.

It is noteworthy that projected shipments of refined product from PADD III to PADD I total about 2.7 million barrels per day in 1990, and that about 2.0 million barrels are projected to be carried in pipelines. Had the transgulf pipeline project materialized, pipeline shipments would have risen by 350,000 barrels per day.

Volumes of oil projected to be carried by tankers are converted into projected demands for tanker tonnage and for numbers of tankers in table 11. For crude oil, the trade routes shown in column 1 include both shipments from PADD V to PADD III and shipments to destinations within PADD V. Despite sizable increases in the production of offshore California oil by 1990, no tanker demand is generated from it because it is allocated to the All American pipeline.

Oil flows in thousands of barrels per day are converted into tanker tonnage demand in thousands of DWT by means of tonnage factors. These factors differ for each route primarily because more tanker capacity is needed to maintain a given flow of oil if a trade route is longer. Tanker tonnage demands are converted into projected numbers of tankers by dividing by average vessel sizes. In this way, 44 crude-carrying tankers with a total capacity of 4.9 million DWT are projected to be commercially viable in 1990. This projection was shown in table 4, and in table 5 it was reported that only 16 of the 44 tankers were considered to be militarily useful. That estimate was obtained by adding the crude-carrying tankers projected to operate on routes characterized by vessels small enough to have military utility.

In addition, although the average vessel size on the route from Valdez to the U.S. West Coast is 124,000 DWT, and the upper limit for a militarily

useful vessel is in the 80,000- to 90,000-DWT range, a few smaller vessels are expected to survive on that route as shown in table 12.

TABLE 12

MILITARILY USEFUL TANKERS IN THE CRUDE TRADES IN 1990

Route		Number
Puerto Armuelles	– USEC	2
Chiriqui Grande	– USG/PR	6
	– USEC	3
Valdez	– Hawaii	2
	– USWC	3
Total		16

The demand for clean-product tankers is projected similarly, but with a few additions. Waterborne shipments of refined products from the Gulf (USG) to the East Coast (USEC) are divided among tankers and barges, with a 58-percent share projected for barges. Both barges and tankers also carry refined products along the East and West Coasts. Estimates for the intracoastal trades could not be made on the basis of volumes of shipments. Rather, projections of active tanker and barge tonnage in these trades were based on National Petroleum Council estimates of 1983 activity. The 1983 tonnage was indexed to the projections of refined product consumption in East and West Coast markets for 1990 and later years. The projection of tankers operating along the East Coast in 1990 includes a few tankers in the trade from the Virgin Islands and Puerto Rico to the East Coast.

PROJECTIONS FOR 1995

A major finding of the study is that the U.S.-flag commercial tanker fleet is expected to decline to its lowest point by 1995, as shown in tables 4 and 5. The portion of the fleet engaged in international carriage – the CDS component – is projected to shrink because subsidy payments will expire; tankers in the domestic trades will continue to diminish in number because of reduced domestic crude oil production. The gap between domestic refined product production and domestic crude production is filled with crude oil imports, carried mainly on foreign-flag ships. In addition, sizable gains in

imports of refined products are anticipated as domestic refineries continue to lose their competitive edge. To the extent that increases in refined product consumption are met by refined product imports, the number of clean-product tankers in the U.S.-flag fleet is smaller than it would have been if domestic refining activity had been greater. The projected relationships between production, imports, and consumption are shown in table 13.

TABLE 13

OIL MARKET PROJECTIONS: AN OVERVIEW
(Thousands of barrels per day)

	1990	1995	2000
Crude oil production	7,600	5,500	7,000
(Alaskan North Slope)	1,800	1,200	1,500
Crude oil imports	6,000	8,500	7,000
Refined product production	13,600	14,000	14,000
Refined product imports	2,400	3,910	4,590
Consumption	17,500	19,600	20,380

The detailed projections of oil flows and their translation into projections of Jones Act tankers are displayed in tables 14 through 18. Earlier it was observed that the demand for Jones Act crude-carrying tankers is derived entirely from shipments of crude oil within PADD V and from PADD V to other PADDs. By 1995, shipments from PADD V are projected to be 103,000 barrels per day, down from 737,000 in 1990 (see table 14). The reason is that the declines in domestic crude output are filled by additional imports directly to East and Gulf Coast refineries, not to the West Coast. Production in Alaska and California is fed to local (PADD V) refineries. As a result, *shipments of crude oil through the Panama Canal dry up*; the little PADD V crude that is shipped east is sent via pipeline. This projected pattern of shipments can be seen in table 16, and the derivation of crude-carrying Jones Act tankers is shown in table 18. From 1990 to 1995 that segment of the fleet is expected to decline from 44 vessels down to 23. In contrast, projected numbers of refined-product tankers change little from what they were in 1990. As noted earlier, once crude is refined on the Gulf Coast, it must be shipped in U.S.-flag tankers or barges or by pipeline. The source of the crude—domestic or foreign—makes no difference. The only loss to the clean-product fleet is an "opportunity loss." With greater domestic refinery capability, the number of clean-product tankers would have grown.

TABLE 14

PROJECTED CRUDE OIL
FLOWS IN 1995
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Crude oil production	55	495	2,365	440	2,145	0	5,500
Crude oil imports	1,147	2,244	4,230	50	366	462	8,500
Receipts from other PADDS	0	425	143	0	0	0	
Total crude supply	1,202	3,164	6,738	490	2,511	462	
Uses							
Crude runs	1,162	3,164	6,314	490	2,408	462	14,000
Shipments to other PADDS	40	0	424	0	103	0	
Crude oil exports	0	0	0	0	0	0	0

TABLE 15

PROJECTED REFINED PRODUCT
FLOWS IN 1995
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Refined product production	1,162	3,164	6,314	490	2,408	462	14,000
Refined product imports	2,378	469	587	39	274	164	3,910
Receipts from other PADDS	3,241	1,521	232	90	255	0	
Other product supply	253	414	1,311	69	253	0	2,300
Total product supply	7,034	5,568	8,443	688	3,190	626	20,210
Uses							
Refined product consumption	6,174	5,096	4,508	617	2,940	265	19,600
Shipments to other PADDS	829	429	3,648	71	0	361	
Product exports	31	43	287	0	250	0	610

TABLE 16

PROJECTED INTER-PADD CRUDE OIL
FLOWS IN 1995
(Thousands of barrels per day)

	Receipts						
Shipments	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	0	40	0	0	0	40
PADD II	0	0	0	0	0	0	0
PADD III	0	382	0	0	0	0	382
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	103	0	0	0	103
VI/PR	0	0	0	0	0	0	0
Total	0	382	143	0	0	0	525
			WATERBORNE				
PADD I	0	0	0	0	0	0	0
PADD II	0	0	0	0	0	0	0
PADD III	0	42	0	0	0	0	42
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	0	0	0	0	0
VI/PR	0	0	0	0	0	0	0
Total	0	42	0	0	0	0	42
			TOTAL				
PADD I	0	0	40	0	0	0	40
PADD II	0	0	0	0	0	0	0
PADD III	0	424	0	0	0	0	424
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	103	0	0	0	103
VI/PR	0	0	0	0	0	0	0
Total	0	424	143	0	0	0	567

TABLE 17

PROJECTED INTER-PADD REFINED PRODUCT
FLOWS IN 1995
(Thousands of barrels per day)

	Receipts						
Shipments	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	564	0	0	0	0	564
PADD II	107	0	176	90	0	0	373
PADD III	2,035	590	0	0	220	0	2,845
PADD IV	0	35	0	0	35	0	70
PADD V	0	0	0	0	0	0	0
VI/PR	0	0	0	0	0	0	0
Total	2,142	1,189	176	90	255	0	3,852
			WATERBORNE				
PADD I	0	265	0	0	0	0	265
PADD II	0	0	56	0	0	0	56
PADD III	730	66	0	0	0	0	804
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	0	0	0	0	0
VI/PR	361	0	0	0	0	0	361
Total	1,099	331	56	0	0	0	1,486
			TOTAL				
PADD I	0	829	0	0	0	0	829
PADD II	107	0	232	90	0	0	429
PADD III	2,773	656	0	0	220	0	3,649
PADD IV	0	35	0	0	35	0	70
PADD V	0	0	0	0	0	0	0
VI/PR	361	0	0	0	0	0	361
Total	3,241	1,520	232	90	255	0	5,338

TABLE 18

PROJECTED U.S.-FLAG DOMESTIC TANKER DEMAND IN 1995

		Thousands of barrels per day	Factor	Thousands of DWT	Average size of vessel	Number of vessels
Crude Oil						
Alaskan North Slope						
Valdez	– USWC	1,163	2.20	2,558	124	21
	– Panama	0	4.63	0	178	0
	– Hawaii	36	2.67	96	73	2
	– VI (via Cape)	0	– [a]	– [a]	– [a]	– [a]
Puerto Armuelles						
	– USG/PR	0		0		0
	– USEC	0	3.14	0	50	0
Chiriqui Grande						
	– USG/PR	0	1.79	0	50	0
	– USEC	0	2.37	0	50	0
Total Alaskan North Slope				2,654		23
Offshore California						
	– USG	0	5.31	0	43	0
	– USEC	0	5.72	0	41	0
Refined-petroleum product						
Tanker shipments						
USG	– USEC	314	2.0	628	38	17
USWC	– USWC			590	38	16
USEC	– USEC			174	38	5
Total tanker shipments				1,392		38
Barge shipments						
USG	– USEC	416	1.25	520	20	26
USWC	– USWC			250	20	13
USEC	– USEC			814	20	41
Total barge shipments				1,584		80

a. Shipments to the Virgin Islands are not covered under the Jones Act; they can be carried in foreign-flag tankers.

An important qualification is that the unit cost of shipments through the All American pipeline might be driven sufficiently high when volumes are in the range of 100,000 barrels per day so that it would be uneconomical to use it. If so, a small volume of crude—103,000 barrels per day—might move by tanker to the Gulf Coast rather than by pipeline. The Valdez-to-Panama carriage would sustain three additional large crude carriers, and the Chiriqui Grande-to-Gulf Coast movement would sustain another four militarily useful ships. Should this occur, the tanker shortfall in 1995 would be a little lower than the projections in tables 1 and 3 indicate. Specifically, available militarily useful tonnage would be higher by 184,000 DWT, or seven HSTEs. Given the bleak outlook for oil production in Alaska and the West Coast, the wisdom of proceeding with the All American pipeline appears dubious. Nonetheless, the project is moving ahead.

PROJECTIONS FOR 2000 AND 2010

After declining to a low in 1995, the U.S.-flag commercial fleet is projected to recover somewhat by 2000. The CDS fleet continues to shrink as ODS contracts expire, but these declines are more than offset by moderate growth of the Jones Act fleet in conjunction with higher levels of domestic crude oil production (see table 13). The rationale for this reversal is that low oil prices encourage consumption, but they discourage the exploration, drilling, and development needed to enhance domestic supply. In the short run, it is cheaper to import; but in the longer run, world demand grows faster than world supply. Prices recover, providing renewed incentives to find and develop domestic fields.

The tanker projections for 2000 are shown in tables 4 and 5. Although the tanker fleet as a whole grows a little between 1995 and 2000, the militarily useful component of it remains unchanged. Higher domestic crude oil output creates a market for additional crude carriers that are likely to be too large to have much military value. By 2010, domestic oil output is projected to have turned down again, and the militarily useful tanker fleet will decrease a little as well. *Thus, the bottom line for the Navy is that the militarily useful part of the tanker fleet will hit bottom around 1995, with about 70 tankers with a total capacity of almost 3 million DWT.* This count is the sum of the 51 tankers projected to remain in the commercial fleet (shown in table 5) and 19 MSC tankers. Sets of tables for the projections for 2000 and 2010 are provided in the appendix.

ALTERNATIVE SCENARIOS

The projections reported above are those deemed most likely to occur and are denoted as the control projection. The same methodology can be employed to generate alternative projections, and in that way gauge the sensitivity of the results. Two alternatives are summarized here, one for the case of substantially higher crude oil production, and the other for the case where exports of Alaskan crude oil are permitted.

The effect of higher crude oil production, possibly stemming from stronger-than-anticipated oil prices, is shown in table 19. The tanker shortfall is the difference between tanker requirements for military support—7,416,000 DWT—and the sum of the projected tonnage in the MSC, U.S. commercial, and EUSC militarily useful tanker fleets. Thus, the tanker shortfall represents the size requirement for the tanker portion of the RRF. Although the effect of stronger production is to lessen the RRF requirement, even under these highly optimistic circumstances, by 1995 the RRF tanker fleet would have to be about double the size DOD currently has programmed for 1990. A full set of tables for this alternative projection is also in the appendix.

TABLE 19

SENSITIVITY OF THE TANKER SHORTFALL TO DOMESTIC CRUDE OIL PRODUCTION

	Alternative case		Control case	
	1990	1995	1990	1995
Total crude oil production (thousands of barrels per day)	8,800	7,800	7,600	5,500
Alaskan North Slope production (thousands of barrels per day)	1,800	1,700	1,800	1,200
Militarily useful tanker tonnage[a] (thousands of DWT)	5,255	4,831	4,554	3,864
Tanker shortfall:[b]				
in thousands of DWT	2,161	2,585	2,862	3,552
in HSTE	79	94	104	129

a. The sum of the MSC, U.S. commercial, and EUSC available militarily useful tankers.
b. Tanker requirements for military support (7,416) less militarily useful tanker tonnage in line 3.

The other alternative, the Alaskan export scenario, is summarized in table 20. The assumption is that 200,000 barrels per day of Alaskan crude oil are exported to Japan. Under current maritime policy, those shipments would not fall under the Jones Act, and in all probability would be carried in foreign-flag tankers. In this scenario, the crude oil sent to Japan is replaced by increased imports to the Gulf and East Coasts. About 14 tankers would be displaced in 1990, but only 9 would be small enough to be militarily useful. In 1995, a displacement of 5 militarily useful tankers would occur, because Alaskan production is projected to be too low to warrant exporting 200,000 barrels per day. Only about half that amount might be exported. The details of this scenario are reported in tables in the appendix.

TABLE 20

ALASKAN EXPORT SCENARIO

	U.S.-flag tanker capacity displaced			
	1990		1995	
	Tankers	DWT	Tankers	DWT
Total	14	1,361	0	0
Valdez to Panama	5	926	3	0
Panama to Gulf/EC	9	435	5	0
Militarily useful	9	435	5	0

REFERENCES

[1] Department of Defense, Office of the Director, Program Appraisal and Evaluation, *DOD Sealift Tanker Study* (U), Secret, Jul 1985

[2] Department of Transportation, Maritime Administration, *Economic Support Shipping*, Unclassified, Apr 1985

[3] CNA, Research Contribution 539, *A Methodology for Projecting U.S.-Flag Commercial Tanker Capacity*, by Ronald F. Rost, Unclassified, Mar 1986

APPENDIX

PROJECTION TABLES

APPENDIX

PROJECTION TABLES

This appendix provides additional projection tables for oil flows for the future. Included are the following:

TABLE A-1

PROJECTED CRUDE
OIL FLOWS IN 2000
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Crude oil production	70	630	2,870	630	2,800	0	7,000
Crude oil imports	1,044	1,848	3,383	42	302	381	7,000
Receipts from other PADDS	88	686	565	0	0	81	
Total crude supply	1,202	3,164	6,818	672	3,102	462	14,000
Uses							
Crude runs	1,162	3,164	6,314	490	2,408	462	14,000
Shipments to other PADDS	40	0	504	182	694	0	
Crude oil exports	0	0	0	0	0	0	0

TABLE A-2

PROJECTED REFINED PRODUCT
FLOWS IN 2000
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Refined product production	1,162	3,164	6,314	490	2,408	462	14,000
Refined product imports	2,792	551	689	46	321	191	4,590
Receipts from other PADDS	3,254	1,641	241	94	314	0	
Other product supply	264	432	1,368	72	264	0	2,400
Total product supply	7,472	5,788	8,611	702	3,307	653	20,990
Uses							
Refined product consumption	6,420	5,299	4,687	642	3,057	275	20,380
Shipments to other PADDS	1,022	446	3,637	60	0	378	
Product exports	31	43	287	0	250	0	610

TABLE A-3

PROJECTED INTER-PADD
CRUDE OIL FLOWS IN 2000
(Thousands of barrels per day)

	Receipts						
Shipments	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	0	40	0	0	0	40
PADD II	0	0	0	0	0	0	0
PADD III	0	454	0	0	0	0	454
PADD IV	0	182	0	0	0	0	182
PADD V	0	0	400	0	0	0	400
VI/PR	0	0	0	0	0	0	0
Total	0	636	440	0	0	0	1,076
			WATERBORNE				
PADD I	0	0	0	0	0	0	0
PADD II	0	0	0	0	0	0	0
PADD III	0	50	0	0	0	0	50
PADD IV	0	0	0	0	0	0	0
PADD V	88	0	124	0	0	81	293
VI/PR	0	0	0	0	0	0	0
Total	88	50	124	0	0	81	343
			TOTAL				
PADD I	0	0	40	0	0	0	40
PADD II	0	0	0	0	0	0	0
PADD III	0	504	0	0	0	0	504
PADD IV	0	182	0	0	0	0	182
PADD V	88	0	524	0	0	81	693
VI/PR	0	0	0	0	0	0	0
Total	88	686	564	0	0	81	1,419

TABLE A-4

PROJECTED INTER-PADD REFINED PRODUCT
FLOWS IN 2000
(Thousands of barrels per day)

	Receipts						
Shipments	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	695	0	0	0	0	695
PADD II	111	0	183	94	0	0	388
PADD III	2,027	530	0	0	284	0	2,841
PADD IV	0	30	0	0	30	0	60
PADD V	0	0	0	0	0	0	0
VI/PR	0	0	0	0	0	0	0
Total	2,138	1,255	183	94	314	0	3,984
			WATERBORNE				
PADD I	0	327	0	0	0	0	327
PADD II	0	0	58	0	0	0	58
PADD III	737	59	0	0	0	0	796
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	0	0	0	0	0
VI/PR	378	0	0	0	0	0	378
Total	1,115	386	58	0	0	0	1,559
			TOTAL				
PADD I	0	1,022	0	0	0	0	1,022
PADD II	111	0	241	94	0	0	446
PADD III	2,764	589	0	0	284	0	3,637
PADD IV	0	30	0	0	30	0	60
PADD V	0	0	0	0	0	0	0
VI/PR	378	0	0	0	0	0	378
Total	3,253	1,641	241	94	314	0	5,543

TABLE A-5

PROJECTED U.S.-FLAG DOMESTIC TANKER DEMAND IN 2000

		Thousands of barrels per day	Factor	Thousands of DWT	Average size of vessel	Number of vessels
Crude oil						
Alaskan North Slope						
Valdez	– USWC	1,161	2.20	2,555	124	21
	– Panama	232	4.63	1,074	178	6
	– Hawaii	45	2.67	120	73	2
	– VI (via Cape)	62	– [a]	– [a]	– [a]	– [a]
Puerto Armuelles						
	– USG/PR	0	0	0	50	0
	– USEC	29	3.14	91	50	2
Chiriqui Grande						
	– USG/PR	144	1.79	257	50	5
	– USEC	59	2.37	140	50	3
Total Alaskan North Slope				4,237		39
Offshore California						
	– USG	0	5.31	0	43	0
	– USEC	0	5.72	0	41	0
Refined petroleum product						
Tanker shipments						
USG	– USEC	317	2.0	634	38	17
USWC	– USWC			614	38	16
USEC	– USEC			181	38	5
Total tanker shipments				1,429		38
Barge shipments						
USG	– USEC	420	1.25	525	20	26
USWC	– USWC			260	20	13
USEC	– USEC			846	20	42
Total barge shipments				1,631		81

a. Shipments to the Virgin Islands are not covered under the Jones Act; they can be carried in foreign-flag tankers.

TABLE A-6

PROJECTED CRUDE
OIL FLOWS IN 2010
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Crude oil production	60	540	2,340	540	2,520	0	6,000
Crude oil imports	1,052	2,112	3,981	48	345	462	8,000
Receipts from other PADDS	90	512	407	0	0	0	
Total crude supply	1,202	3,164	6,728	588	2,865	462	14,000
Uses							
Crude runs	1,162	3,164	6,314	490	2,408	462	14,000
Shipments to other PADDS	40	0	414	98	457	0	
Crude oil exports	0	0	0	0	0	0	0

TABLE A-7

PROJECTED REFINED PRODUCT
FLOWS IN 2010
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Refined product production	1,162	3,164	6,314	490	2,408	462	14,000
Refined product imports	3,831	751	939	63	438	238	6,260
Receipts from other PADDS	3,200	1,910	260	101	447	0	
Other product supply	264	432	1,368	72	264	0	2,400
Total product supply	8,457	6,257	8,881	726	3,558	700	22,660
Uses							
Refined product consumption	6,946	5,733	5,071	695	3,308	298	22,050
Shipments to other PADDS	1,480	481	3,523	31	0	403	
Product exports	31	43	287	0	250	0	610

TABLE A-8

PROJECTED INTER-PADD
CRUDE OIL FLOWS IN 2010
(Thousands of barrels per day)

Shipments	Receipts						
	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	0	40	0	0	0	40
PADD II	0	0	0	0	0	0	0
PADD III	0	373	0	0	0	0	373
PADD IV	0	98	0	0	0	0	98
PADD V	0	0	367	0	0	0	367
VI/PR	0	0	0	0	0	0	0
Total	0	471	407	0	0	0	878
			WATERBORNE				
PADD I	0	0	0	0	0	0	0
PADD II	0	0	0	0	0	0	0
PADD III	0	41	0	0	0	0	41
PADD IV	0	0	0	0	0	0	0
PADD V	90	0	0	0	0	0	90
VI/PR	0	0	0	0	0	0	0
T otal	90	41	0	0	0	0	131
			TOTAL				
PADD I	0	0	40	0	0	0	40
PADD II	0	0	0	0	0	0	0
PADD III	0	414	0	0	0	0	414
PADD IV	0	98	0	0	0	0	98
PADD V	90	0	367	0	0	0	457
VI/PR	0	0	0	0	0	0	0
Total	90	512	407	0	0	0	1,009

TABLE A-9

PROJECTED INTER-PADD REFINED PRODUCT FLOWS IN 2010
(Thousands of barrels per day)

Shipments	Receipts						
	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	474	0	0	0	0	474
PADD II	120	0	197	101	0	0	418
PADD III	1,952	372	0	0	431	0	2,755
PADD IV	0	16	0	0	16	0	32
PADD V	0	0	0	0	0	0	0
VI/PR	0	0	0	0	0	0	0
Total	2,072	862	197	101	447	0	3,679
			WATERBORNE				
PADD I	0	1,007	0	0	0	0	1,007
PADD II	0	0	62	0	0	0	62
PADD III	725	41	0	0	0	0	766
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	0	0	0	0	0
VI/PR	403	0	0	0	0	0	403
Total	1,128	1,048	62	0	0	0	2,238
			TOTAL				
PADD I	0	1,480	0	0	0	0	1,408
PADD II	120	0	260	101	0	0	481
PADD III	2,677	414	0	0	432	0	3,523
PADD IV	0	16	0	0	15	0	31
PADD V	0	0	0	0	0	0	0
VI/PR	403	0	0	0	0	0	403
Total	3,200	1,910	260	101	447	0	5,918

TABLE A-10

PROJECTED U.S.-FLAG DOMESTIC TANKER DEMAND IN 2010

		Thousands of barrels per day	Factor	Thousands of DWT	Average size of vessel	Number of vessels
Crude oil						
Alaskan North Slope						
Valdez	– USWC	1,656	2.20	3,643	124	30
	– Panama	90	4.63	417	178	2
	– Hawaii	54	2.67	144	73	2
	– VI (via Cape)	0	– [a]	– [a]	– [a]	– [a]
Puerto Armuelles						
	– USG/PR	0	2.43	0	50	0
	– USEC	30	3.14	94	50	2
Chiriqui Grande						
	– USG/PR	0	1.79	0	50	0
	– USEC	60	2.37	142	50	3
Total Alaskan North Slope				4,440		39
Offshore California						
	– USG	0	5.31	0	43	0
	– USEC	0	5.72	0	41	0
Refined petroleum product						
Tanker shipments						
USG	– USEC	312	2.0	624	38	16
USWC	– USWC			664	38	18
USEC	– USEC			196	38	5
Total tanker shipments				1,484		39
Barge shipments						
USG	– USEC	413	1.25	516	20	26
USW	– USWC			282	20	14
USE	– USEC			916	20	46
Total barge shipments				1,714		86

a. Shipments to the Virgin Islands are not covered under the Jones Act; they can be carried in foreign-flag tankers.

TABLE A-11

HIGH PRODUCTION ALTERNATIVE FOR
CRUDE OIL FLOWS IN 1990
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Crude oil production	88	880	3,960	616	3,256	0	8,800
Crude oil imports	839	1,280	2,361	25	220	275	5,000
Receipts from other PADDS	263	959	704	0	0	180	
Total crude supply	1,190	3,119	7,025	641	3,476	455	13,800
Uses							
Crude runs	1,145	3,119	6,224	483	2,374	455	13,800
Shipments to other PADDS	45	0	801	158	1,102	0	
Crude oil exports	0	0	0	0	0	0	0

TABLE A-12

HIGH PRODUCTION ALTERNATIVE FOR
REFINED PRODUCT FLOWS IN 1990
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Refined product production	1,145	3,119	6,224	483	2,374	455	13,800
Refined product imports	928	192	240	16	112	112	1,600
Receipts from other PADDS	3,258	1,148	217	84	64	0	
Other product supply	231	378	1,197	63	231	0	2,100
Total product supply	5,562	4,837	7,877	646	2,781	567	17,500
Uses							
Refined product consumption	5,323	4,394	3,887	532	2,535	228	16,900
Shipments to other PADDS	209	401	3,708	114	0	339	
Product exports	30	402	282	0	246	0	600

TABLE A-13

HIGH PRODUCTION ALTERNATIVE FOR INTER-PADD
CRUDE OIL FLOWS IN 1990
(Thousands of barrels per day)

Shipments	Receipts						
	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	0	45	0	0	0	45
PADD II	0	0	0	0	0	0	0
PADD III	0	721	0	0	0	0	721
PADD IV	0	158	0	0	0	0	158
PADD V	0	0	400	0	0	0	400
VI/PR	0	0	0	0	0	0	0
Total	0	879	445	0	0	0	1,324
			WATERBORNE				
PADD I	0	0	0	0	0	0	0
PADD II	0	0	0	0	0	0	0
PADD III	0	80	0	0	0	0	80
PADD IV	0	0	0	0	0	0	0
PADD V	263	0	259	0	0	180	702
VI/PR	0	0	0	0	0	0	0
Total	263	80	259	0	0	180	782
			TOTAL				
PADD I	0	0	45	0	0	0	45
PADD II	0	0	0	0	0	0	0
PADD III	0	801	0	0	0	0	801
PADD IV	0	158	0	0	0	0	158
PADD V	263	0	659	0	0	180	1,102
VI/PR	0	0	0	0	0	0	0
Total	263	959	704	0	0	180	2,106

TABLE A-14

HIGH PRODUCTION ALTERNATIVE FOR
REFINED PRODUCT FLOWS IN 1990
(Thousands of barrels per day)

Shipments	Receipts						
	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	142	0	0	0	0	142
PADD II	100	0	165	84	0	0	349
PADD III	2,074	794	0	0	7	0	2,875
PADD IV	0	57	0	0	57	0	114
PADD V	0	0	0	0	0	0	0
VI/PR	0	0	0	0	0	0	0
Total	2,174	993	165	84	64	0	3,480
			WATERBORNE				
PADD I	0	67	0	0	0	0	67
PADD II	0	0	52	0	0	0	52
PADD III	744	88	0	0	0	0	832
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	0	0	0	0	0
VI/PR	339	0	0	0	0	0	339
Total	1,083	155	52	0	0	0	1,290
			TOTAL				
PADD I	0	209	0	0	0	0	209
PADD II	100	0	217	84	0	0	401
PADD III	2,818	882	0	0	7	0	3,707
PADD IV	0	57	0	0	57	0	114
PADD V	0	0	0	0	0	0	0
VI/PR	339	0	0	0	0	0	339
Total	3,257	1,148	217	84	64	0	4,770

TABLE A-15

HIGH PRODUCTION ALTERNATIVE FOR U.S.-FLAG DOMESTIC TANKER DEMAND IN 1990

		Thousands of barrels per day	Factor	Thousands of DWT	Average size of vessel	Number of vessels
Crude oil						
Alaskan North Slope						
Valdez	– USWC	1,044	2.20	2,296	124	19
	– Panama	565	4.63	2,617	178	15
	– Hawaii	54	2.67	144	73	2
	– VI (via Cape)	137	– [a]	– [a]	– [a]	– [a]
Puerto Armuelles						
	– USG/PR	0		0	50	0
	– USEC	87	3.14	273	50	6
Chiriqui Grande						
	– USG/PR	302	1.79	540	50	11
	– USEC	176	2.37	418	50	8
Total Alaskan North Slope				6,288		61
Offshore California						
	– USG	0	5.31	0	43	0
	– USEC	0	5.72	0	41	0
Refined petroleum product						
Tanker shipments						
USG	– USEC	320	2.0	640	38	17
USWC	– USWC			509	38	14
USEC	– USEC			150	38	4
Total tanker shipments				1,299		35
Barge shipments						
USG	– USEC	424	1.25	530	20	27
USWC	– USWC			216	20	11
USEC	– USEC			702	20	35
Total barge shipments				1,448		73

a. Shipments to the Virgin Islands are not covered under the Jones Act; they can be carried in foreign-flag tankers.

TABLE A-16

HIGH PRODUCTION ALTERNATIVE FOR
CRUDE OIL FLOWS IN 1995
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Crude oil production	78	702	3,354	624	3,042	0	7,800
Crude oil imports	809	1,584	2,986	36	259	326	6,000
Receipts from other PADDS	298	833	540	0	0	129	
Total crude supply	1,185	3,119	6,880	660	3,301	455	13,800
Uses							
Crude runs	1,145	3,119	6,224	483	2,374	455	13,800
Shipments to other PADDS	40	0	656	177	927	0	
Crude oil exports	0	0	0	0	0	0	0

TABLE A-17

HIGH PRODUCTION ALTERNATIVE FOR
REFINED PRODUCT FLOWS IN 1995
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Refined product production	1,145	3,119	6,224	483	2,374	455	13,800
Refined product imports	870	180	225	15	105	105	1,500
Receipts from other PADDS	3,298	1,171	232	90	64	0	
Other product supply	242	396	1,254	66	242	0	2,200
Total product supply	5,555	4,866	7,934	654	2,785	560	17,500
Uses							
Refined product consumption	5,323	4,394	3,887	532	2,535	218	16,890
Shipments to other PADDS	201	429	3,761	122	0	342	
Product exports	31	43	287	0	250	0	610

TABLE A-18

HIGH PRODUCTION ALTERNATIVE FOR INTER-PADD CRUDE OIL FLOWS IN 1995
(Thousands of barrels per day)

	Receipts						
Shipments	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	0	40	0	0	0	40
PADD II	0	0	0	0	0	0	0
PADD III	0	590	0	0	0	0	590
PADD IV	0	177	0	0	0	0	177
PADD V	0	0	400	0	0	0	400
VI/PR	0	0	0	0	0	0	0
Total	0	767	440	0	0	0	1,207
			WATERBORNE				
PADD I	0	0	0	0	0	0	0
PADD II	0	0	0	0	0	0	0
PADD III	0	66	0	0	0	0	66
PADD IV	0	0	0	0	0	0	0
PADD V	298	0	100	0	0	129	527
VI/PR	0	0	0	0	0	0	0
Total	298	66	100	0	0	129	593
			TOTAL				
PADD I	0	0	40	0	0	0	40
PADD II	0	0	0	0	0	0	0
PADD III	0	656	0	0	0	0	656
PADD IV	0	177	0	0	0	0	177
PADD V	298	0	500	0	0	129	927
VI/PR	0	0	0	0	0	0	0
Total	298	833	540	0	0	129	1,800

TABLE A-19

HIGH PRODUCTION ALTERNATIVE FOR INTER-PADD
REFINED PRODUCT FLOWS IN 1995
(Thousands of barrels per day)

	Receipts						
Shipments	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	137	0	0	0	0	137
PADD II	107	0	176	90	0	0	373
PADD III	2,099	818	0	0	4	0	2,921
PADD IV	0	61	0	0	61	0	122
PADD V	0	0	0	0	0	0	0
VI/PR	0	0	0	0	0	0	0
Total	2,206	1,016	176	90	65	0	3,553
			WATERBORNE				
PADD I	0	64	0	0	0	0	64
PADD II	0	0	56	0	0	0	56
PADD III	749	91	0	0	0	0	840
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	0	0	0	0	0
VI/PR	342	0	0	0	0	0	342
Total	1,091	155	56	0	0	0	1,302
			TOTAL				
PADD I	0	201	0	0	0	0	201
PADD II	107	0	232	90	0	0	429
PADD III	2,848	909	0	0	4	0	3,761
PADD IV	0	61	0	0	61	0	122
PADD V	0	0	0	0	0	0	0
VI/PR	342	0	0	0	0	0	342
Total	3,297	1,171	232	90	65	0	4,855

TABLE A-20

HIGH PRODUCTION ALTERNATIVE FOR U.S.-FLAG DOMESTIC TANKER DEMAND IN 1995

		Thousands of barrels per day	Tonnage factor	Thousands of DWT	Average size of vessel	Number of vessels
Crude oil						
Alaskan North Slope						
Valdez	– USWC	1,122	2.20	2,468	124	20
	– Panama	429	4.63	1,986	178	11
	– Hawaii	51	2.67	136	73	2
	– VI (via Cape)	98	– [a]	– [a]	– [a]	– [a]
Puerto Armuelles						
	– USG/PR	0		0		0
	– USEC	98	3.14	309	50	6
Chiriqui Grande						
	– USG/PR	131	1.79	234	50	5
	– USEC	200	2.37	473	50	10
Total Alaskan North Slope				5,606		54
Offshore California						
	– USG	0	5.31	0	43	0
	– USEC	0	5.72	0	41	0
Refined petroleum product						
Tanker shipments						
USG	– USEC	322	2.0	644	38	17
USWC	– USWC			509	38	14
USEC	– USEC			150	38	4
Total tanker shipments				1,303		35
Barge shipments						
USG	– USEC	427	1.25	534	20	27
USWC	– USWC			216	20	11
USEC	– USEC			702	20	35
Total barge shipments				1,452		73

a. Shipments to the Virgin Islands are not covered under the Jones Act; they can be carried in foreign-flag tankers.

TABLE A-21

ALASKAN EXPORT ALTERNATIVE FOR
CRUDE OIL FLOWS IN 1990
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Crude oil production	76	760	3,420	532	2,812	0	7,600
Crude oil imports	1,098	1,536	2,942	30	264	330	6,200
Receipts from other PADDS	0	778	464	0	0	119	
Total crude supply	1,174	3,074	6,826	562	3,076	449	13,800
Uses							
Crude runs	1,129	3,074	6,134	476	2,339	449	13,600
Shipments to other PADDS	45	0	692	86	537	0	
Crude oil exports	0	0	0	0	200	0	200

TABLE A-22

ALASKAN EXPORT ALTERNATIVE FOR INTER-PADD
CRUDE OIL FLOWS IN 1990
(Thousands of barrels per day)

	Receipts						
Shipments	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	0	45	0	0	0	45
PADD II	0	0	0	0	0	0	0
PADD III	0	623	0	0	0	0	623
PADD IV	0	86	0	0	0	0	86
PADD V	0	0	400	0	0	0	400
VI/PR	0	0	0	0	0	0	0
Total	0	709	445	0	0	0	1,154
			WATERBORNE				
PADD I	0	0	0	0	0	0	0
PADD II	0	0	0	0	0	0	0
PADD III	0	69	0	0	0	0	69
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	18	0	0	119	137
VI/PR	0	0	0	0	0	0	0
Total	0	69	18	0	0	119	206
			TOTAL				
PADD I	0	0	45	0	0	0	45
PADD II	0	0	0	0	0	0	0
PADD III	0	692	0	0	0	0	692
PADD IV	0	86	0	0	0	0	86
PADD V	0	0	418	0	0	119	537
VI/PR	0	0	0	0	0	0	0
Total	0	778	463	0	0	119	1,360

TABLE A-23

ALASKAN EXPORT ALTERNATIVE
U.S.-FLAG DOMESTIC TANKER DEMAND IN 1990

		Thousands of barrels per day	Tonnage factor	Thousands of DWT	Average size of vessel	Number of vessels
Crude oil						
Alaskan North Slope						
Valdez	– USWC	1,409	2.20	3,100	124	25
	– Panama	47	4.63	215	178	1
	– Hawaii	54	2.67	144	73	2
	– VI (via Cape)	90	– [a]	– [a]	– [a]	– [a]
Puerto Armuelles						
	– USG/PR	0	2.43	0	50	0
	– USEC	0	3.14	0	50	0
Chiriqui Grande						
	– USG/PR	47	1.79	84	50	2
	– USEC	0	2.37	0	50	0
Total Alaskan North Slope				3,543		30
Offshore California						
	– USG	0	5.31	0	43	0
	– USEC	0	5.72	0	41	0

a. Shipments to the Virgin Islands are not covered under the Jones Act; they can be carried in foreign flag tankers.

TABLE A-24

ALASKAN EXPORT SCENARIO FOR
CRUDE OIL FLOWS IN 1995
(Thousands of barrels per day)

	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
Sources							
Crude oil production	55	495	2,365	440	2,145	0	5,500
Crude oil imports	1,147	2,244	4,333	51	363	462	8,600
Receipts from other PADDS	0	425	41	0	0	0	
Total crude supply	1,202	3,164	6,739	491	2,508	462	14,100
Uses							
Crude runs	1,162	3,164	6,314	491	2,408	462	14,000
Shipments to other PADDS	40	0	425	0	0	0	
Crude oil exports	0	0	0	0	100	0	100

TABLE A-25

ALASKAN EXPORT SCENARIO FOR PROJECTED
INTER-PADD CRUDE OIL FLOWS IN 1995
(Thousands of barrels per day)

	Receipts						
Shipments	PADD I	PADD II	PADD III	PADD IV	PADD V	VI/PR	Total
			PIPELINE				
PADD I	0	0	40	0	0	0	40
PADD II	0	0	0	0	0	0	0
PADD III	0	383	0	0	0	0	383
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	0	0	0	0	0
VI/PR	0	0	0	0	0	0	0
Total	0	383	40	0	0	0	423
			WATERBORNE				
PADD I	0	0	0	0	0	0	0
PADD II	0	0	0	0	0	0	0
PADD III	0	42	0	0	0	0	42
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	0	0	0	0	0
VI/PR	0	0	0	0	0	0	0
Total	0	42	0	0	0	0	42
			TOTAL				
PADD I	0	40	0	0	0	0	40
PADD II	0	0	0	0	0	0	0
PADD III	0	425	0	0	0	0	425
PADD IV	0	0	0	0	0	0	0
PADD V	0	0	0	0	0	0	0
VI/PR	0	0	0	0	0	0	0
Total	0	425	40	0	0	0	465

TABLE A-26

ALASKAN EXPORT SCENARIO FOR U.S.-FLAG
DOMESTIC TANKER DEMAND IN 1995

		Thousands of barrels per day	Factor	Thousands of DWT	Average size of vessel	Number of vessels
Crude oil						
Alaskan North Slope						
Valdez	– USWC	1,064	2.20	2,340	124	19
	– Panama	0	4.63	0	178	0
	– Hawaii	36	2.67	96	73	2
	– VI (via Cape)	0	– [a]	– [a]	– [a]	– [a]
Puerto Armuelles						
	– USG/PR	0	2.43	0		0
	– USEC	0	3.14	0	50	0
Chiriqui Grande						
	– USG/PR	0	1.79	0	50	0
	– USEC	0	2.37	0	50	0
Total Alaskan North Slope				2,655		21
Offshore California						
	– USG	0	5.31	0	43	0
	– USEC	0	5.72	0	41	0

a. Shipments to the Virgin Islands are not covered under the Jones Act; they can be carried in foreign-flag tankers.

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